VERIFIED TRANSLATION OF PRIORITY DOCUMENT (37 CFR 1.55(A))

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That I am knowledgeable in the English language, and in the German language of the patent application from which priority is claimed for this application;

The priority document is attached.

I hereby state that the attached translation of the priority document that I have prepared is accurate.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

The priority document attached is further identified as:

Title: **S&S-99/1074a "Stretch Process"**

FULL NAME OF THE TRANSLATOR: MORGAN C. LARKIN

SIGNATURE OF THE TRANSLATOR: Morgan C. Larkin Date: Jan. 22, 2001

POST OFFICE ADDRESS: 2445 MYRTLE AVENUE NE, SALEM, OR 97303

State of Oregon)

) ss.

County of Marion)

Sworn to and subscribed before me this 22 th day of January, 2001

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Sharon E Johnstone

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99/1074b

A process and ~~an~~ apparatus for stretching textile fibers

Description

The invention concerns a process for the stretching of textile fibers as well as an apparatus therefor, wherein the apparatus possesses a stretch chamber, within which fibers are stretched.

Processes of this kind have long been carried out in stretch apparatuses having roll pairs placed sequentially, one after the other. In this procedure, a roll pair is formed by a so-called cylinder and a pressure roll which are aligned with parallel axes and turn in opposite directions. The respective cylinder and pressure roll of the pair rolls, as stated, following sequentially, one after the other, rotate with increasing speed. The fibers (in the form of one or more fiber bands), are consolidated between the cylinder and the pressure roll and are taken through each respective roll pair at the rotational speed of that roll pair, whereby, a stretching of the fibers between each roll pair is achieved. These known and established processes are today from technical standpoints, almost abandoned.

The purpose of the invention comprises the development of a process as well as of an apparatus of the type mentioned in the introductory passages so that, by the introduction of new technologies, prerequisites for parameter optimization in the tensioning process are created.

This purpose is achieved by the process of the introductory type, in that at least one fluid is brought to the fibers to be stretched, in such a fashion, that it entrains said fibers and at least, brings into play a part of the force necessary for stretching.

This purpose is achieved by an apparatus of the kind mentioned in the introductory passages, in that, a feed device, for the inlet of at least one fluid to the fibers which have been brought into the stretch chamber, and further, the said feed device is so constructed, that the inlet fluid exerts at least a part of the necessary tensile force for the stretching of the fibers.

The advantages of the invention, are especially comprised therein, in that at least one fluid is conducted to the fibers to be stretched, in order, either to completely execute the stretching process or to act as auxiliary thereto. For the production of a relative movement of the fibers between one another, one fiber must be restrained, and a second, relative to the first, accelerated. Restraining and accelerating are achieved in the conventional stretchworks by the consolidation of the concerned fibers in roll pairs which pairs are situated sequentially apart from one another in the direction of the stretching and which turn at various rotational speeds. In the case of a stretchworks functioning with at least one fluid, the fibers are likewise, factually consolidated, in that the fluid entrains the fibers and restrains some, as other fibers are accelerated. In order to permit this to occur, a necessary inter-fiber cohesive friction must be overcome on the fibers to be stretched. In accord with the invention, at least one fluid medium must be brought in as support for the process of acceleration and restraint.

The fluid exerts, in accord with the purpose, a force to accelerate a fiber portion in the direction conducive to stretching. Alternatively, or additionally, at least one, or another fluid, entrains the desired slower fibers and restrains or retains these in comparison to the fibers moving more quickly. For the attainment of this consolidation or restraining action, the at least one fluid, first can exhibit a flow component, and thus a force component on the fiber in the stretching direction. This force, however, must be less than the pulling forces holding the more rapidly moving fibers. This is comparable to the situation in conventional stretchworks, in which the upstream roll pair shows a lesser RPM than does the downstream pair. Second, the at least one fluid can possess also a flow component and thus a force component counter to the stretching direction, and in this way restrain or restrain the fibers in involved. For the acceleration of a part of the fibers and the restraining of another part, different fluids can be employed.

The at least one fluid can completely or supportingly accelerate those fibers, where velocity is considered, which are in a state of more rapid motion and or, in comparison to these, restrain the more slowly traveling fibers.

As an example for a supportive action, at least one fluid can be employed in addition to the use of mechanical stretch work rolls. This fluid will thus stretch the fibers, and assist in the stretch. The fluid, in such a case, could undertake a very flexible role. For instance, by means of a change in pressure of the fluid, the force acting on the fibers can be quickly and precisely changed . Also, in the general stretching process, a penetration into the more inner lying fibers of a fiber band becomes more effective with a fluid than with a purely mechanical stretchworks.

By the choice of a selected flow of the fluid, the cleansing effect comes into play, that is, very short and therefore undesirable fibers can be removed from the fluid flow by flow carrying relatively low kinetic force, and additionally the longer fibers are removed by a flow at a correspondingly a higher kinetic force. The flow direction of the fluid can, in this case, likewise be adjusted to the requirements of a specific application.

In the case of the procedure in accord with the invention, all possible fluid media may be employed, that is, a liquid, a gas, a gas mixture or a combination of at least two of the said media. In accordance with the type of fiber to be stretched, the fiber length and thickness, the most appropriate fluid for the application can be selected, which, obviously, along with model-computing, requires a certain empirical know-how.

The employment of water, air or a combination of water and air is especially low in cost.

In order to put to use the kinetic force of the flow efficiently, the apparatus in accord with the invention possesses an essentially tightly sealed stretch chamber. Fiber and fluid inlets as well as outlets for the same are advantageously provided and sealed.

In an advantageous embodiment of the invention, the stretch chamber possesses several, progressively narrowing, stretch chamber sections, arranged stagewise or continuously in the stretching direction. Because of the geometric design of the stretch chamber, the fluid flows at an increasing velocity in the stretch direction, thereby carrying the fibers along with it. The fibers, which are still found in the upstream sections of the stretch chamber are accordingly accelerated more slowly. In this manner, higher velocities of a portion of the fibers at the outlet of the stretch chamber can be assured.

In this embodiment of the invention, the fluid can entrain the fibers along its entire stretch chamber length. The fibers, thus, can be consolidated over the complete length of the stretchworks chamber and restrained, relative to one another or can be accelerated.

Those fibers, which, during the process of stretching, should experience relatively little acceleration, can be retained behind the more rapid fibers by a relatively low kinetic force flow in the stretch direction or also by a flow in a reverse direction. Additionally or alternatively, the necessary restraining force can, at least partially, be exercised by mechanical, pneumatic and/or electrostatic action on those fibers, which during the stretching procedure remain behind the more accelerated fibers. For instance, to achieve the stretching, a consolidation roll holds a portion of the fibers back, so that another part of the fibers can be moved in a stretching direction by means of fluids flowing in the said stretching direction, and/or, if necessary, moved by an additional mechanical stretching device, for instance, again, a roll.

If first, a counter directed flow, or second, a fluid flowing relatively slowly in the stretching direction, restrains the slower, that is the consolidated fibers in the come-along effect entrained with more rapidly accelerated fibers, then this fluid is advantageously the same fluid as that fluid acting in the stretching direction, that is, being water or air. The counter flow can, for example, in the manner of the fluid which accelerates the fibers, be directed by means of conducting lines to its position of activity, i.e. injection. Alternative or additionally, correspondingly designed nozzles can be installed. These are advantageously so placed and constructed, that they can efficiently entrain the fibers and these fibers, in relation to one another, are thereby accelerated or restrained. In the way of example, several nozzles are placed about the fiber band(s) or about the relatively loose fibers. These nozzles are placed in a plane perpendicular to the stretching direction and essentially, directed either to or against the said stretching direction.

By means of the process in accord with the invention, single fibers mixed together, fiber flocks, or fiber bands can be stretched. In the conventional stretchworks, on the other hand, nearly exclusively fiber bands are stretched, so that the process in accord with the invention can embrace a wider area of application.

Advantageously, the fluid can be applied by means of an injector under appropriately chosen pressure, preferably through direct injection into the stretch chamber. An injector comprises, in this service, for instance a double walled tube with, as seen in cross-section, concentric tube walls. Through the outer tube the fluid with high pressure can be directed, while the inner tube is supplied with fibers. At the outlet of the double tube, the fluid entrains the fibers in the form of thin strands, so that in this way, for instance, out of single fibers, a thin nap can be formed By the use of an injector, it is also possible to suck fibers out of a fiber supply container and transport the same into the stretch chamber. The shape of the injectors the their nozzles can, for this purpose, be adapted to suit the corresponding application circumstances.

For an efficient recycling of the fluid after the one-time through-flow of the stretch chamber, the practical solution is to place the fluid in a circulation system in or outside of the stretch chamber. In some cases, a filter will be necessary, to prevent fiber remains from building up in the circulating fluid. Such buildups lead to pressure variations or, in the worst cases, to complete blockage of the fluid flow tubing.

For instance, in the employment of water at the acting fluid, the twisted fibers cling with greater strength to one another in the fluid, than in the dry state. On this account, a provision is advantageously made, to treat the fibers with an additive to reduce said tendency to cling to one another. For instance, an oil is a usable additive for this purpose, which can be simultaneously employed to pretreat the fibers for subsequent working procedures. In this way, for instance, a cleansing oil can be introduced to the fibers in this step. In this way an economical operational step reduction can be achieved.

The process in accord with the invention can be installed in all spinning machines, in which fibers are to be stretched, particularly in carding and stretch machines. If the process in installed in a stretch machine, then the stretchworks is placed in the mentioned stretch chamber.

If the process in accord with the invention is used in a stretchworks, it can be extended to the stretching operation as a preliminary or subsequent step in the stretch machine.

If the fibers run through, for instance, a carding machine before the entrance into the stretch machine, then the carding process – that is the freeing of single fibers from one another and creating a matting or a tenuous material – can advantageously be at least in part supported by means of the fluid. Also a cleaning of the fibers, can be at least carried out in part by means of the fluid. The carding and if needed, also the cleaning, are advantageously undertaken by the apportioned injection of fluid with a corresponding pressure directed into the fiber volume to be carded. More advantageously, the same fluid is put to use for the carding procedure as is used for stretching in the stretch machine. In this operation, the fluid exiting from the carding machine can be used subsequently for the stretch procedure in the stretch machine, and thereafter again returned to the carding process. Very advantageous, in such a recycling, is to interpose filters for the removal of contamination in the fluid flow.

Likewise, the stretch machine can be installed following a spinning apparatus. In this case, fluid emerging from the stretch chamber – or from a front installed carding machine – can be used for the entwinement of the fibers in the spinning apparatus. Such an entwinement is also known as an "air spinning" operation.

If a fluid is used for the stretching of the fibers, then fibers, after the stretching, in certain cases, are advantageously dried, in order to deposit them in cans or to use them for further work-up. Otherwise, the result would be that the fibers deposited wet could suffer a loss in quality due to the high degree of dampness.

Advantageously, those fiber containers and the feed apparatus related to the stretch chamber for the feed of the fibers are peripherally sealed, in order that a sequence of essentially tightly sealed apparatuses can be created, all of which can be subjected to the fluid. The fluid can then take over various functions. First, it can serve for the removal of the fibers out of the fiber supply container, since, for instance, a nozzle is directed laterally on the first layers of the fibers in the said supply container and conducts these to the stretch chamber. In case the fiber supply container contains single fibers or fiber flocks, and material not yet in a fiber matting state, then, in front of the stretch chamber, advantageously an apparatus for matting making is provided.

This is in order that this matting can be stretched in the stretch chamber. A new and inventive possibility arises in this regard in the application of an injector as described above.

In a particularly advantageous arrangement, the stretching process in accord with the invention and/or the described carding and spinning processes are controlled or regulated, where at least one fluid is employed in the associated control and/or regulatory operational apparatuses. In particular, such a control and/or regulator is employed for the addition of the fluid to the stretch chamber. By means of appropriate sensors, the functions of which are essentially analogous to the known sensors on conventional stretch works, fiber parameters such as fiber band thickness and its uniformity can be determined at the entrance and the exit of the stretch machine. From the sensor collected data, corresponding signals can be transmitted to the control/regulation apparatus(es). Such an arrangement controls and/or regulates advantageously also the feed apparatuses for the fluid, in order that the matching pressure i.e. tensile forces, are brought to bear. Advantageously, in accord with the flow cross-sections of the fluid, the pressure and/or duration of application can be controlled/regulated.

Advantageous developments of the invention become evident in the features of the subordinate claims.

In the following, the invention, with the aid of the drawings, will be more closely described. There is shown in:

Fig. 1 a schematic presentation of a first embodiment of the stretch apparatus in accord with the invention,

Fig. 2 a schematic presentation of a fiber band with two consolidated sections because of flowing fluid in a stretching apparatus,

Fig. 3 a schematic presentation of a fiber band with two consolidated sections because of not only the situation of Fig. 2, but also because of a fluid flowing in a counter direction in said apparatus, and

Fig. 4. a schematic presentation of a second embodiment of the stretch apparatus in accord with the invention.

In Fig. 1, a stretch chamber 1 is schematically depicted for the stretching of the fibers 6 of a fiber band. The stretch chamber 1 is shown with an inlet 9, followed by three subsequent sections 2, 3 and 4, which are telescopically arranged, and progressively smaller. These sections extend themselves in the direction of stretching V toward an outlet 8 of the said stretch chamber 1. The fibers 6, which are stretched in relation to one another, are conducted through this said telescopically arranged chamber to the mentioned outlet 8. A supply container 20 is sealingly attached to the stretch chamber 1, from which the fiber band to be stretched is drawn through a transition hood 10 to the entry 9 of the described stretch chamber 1. In order to guide the fiber band into the stretching direction V, which runs parallel to the longitudinal axis of the stretch chamber 1, a change of direction roll 5 is provided at the entry 9 of the stretch chamber 1. In the transition hood 10, is found a top located, tube-like feed entry, through which a fluid 7 is guided into the stretch chamber 1. In this operation, a deflection vane 13 serves to divert at least a portion of the flow of fluid 7 toward the entry 9 of the stretch chamber 1. In its most simple construction, the said deflection vane 13 is a plain sheet of sheet metal.

Since both the fiber supply container 20 as well as the transition hood 10 possess the same cross-section, they can be coupled together by means of peripheral sealants 15, 25, and if necessary an additional clamping means. This will prevent first, ambient air from entering in significant quantities into the system stretch chamber 1, transition hood 10, and fiber supply container 20, and second, prevent the loss of fluid 7 from within the system.

The fiber band, that is, the fibers 6, can be transported by various means from the fiber supply container 20 to the stretch chamber 1. An embodiment (not shown) prefers a mechanical transport, for instance by a comb pick-up roll or like transport. As an alternative, also a flowing fluid 7 can be put to use, more advantageously, the fluid 7 in this service is the same fluid 7 which is being employed for the stretching operation. Especially, in the case of supply containers 20, filled with single fibers and fiber flocks, a laterally placed nozzle, directed on an upward slant can be penetratingly installed.

The said nozzles would be installed slightly under the fiber surface and be movable in the vertical direction.

The fibers 6 in the flowing fluid 7 would be entrained in an upward flow from said nozzles, and transported to the stretch chamber 1. Also a suction removal apparatus for taking the fibers 6 out of the supply container 20 can be installed. In order to avoid a possible low pressure in the fiber supply container 20 by the flow in the stretch chamber 1, a valve 21 is provided, which can be activated either manually or electrically.

Because of the telescopic formation of the stretch chamber 1, the fluid 7, from section to section, i.e. 2 to 3 to 4, in the stretching direction V is progressively more strongly accelerated and, in section 4 (or 3) can correspondingly, in the smaller cross-section, effect a stronger come-along and consolidation force on the fibers 6 found there and provide a greater acceleration for said fibers, than was the case in the section 3 and 2 (or 2) where larger cross-sections were in order. Schematically, this situation is presented in Fig. 2. For the sake of simplicity, in Fig. 2 only two consolidation sections 30, 31 shown, which represent the two sections of the 2, 3, 4 arrangement of Fig. 1. In Fig. 2 the arrows assigned to the fibers 6 represent, in their direction and length, the tensile, entraining forces acting in the respective consolidation positions 30 and 31 on the said fibers 6. It is also possible, to inject different fluids 7 into the said consolidation positions 30 and 31.

As is depicted in Fig. 3, it is possible for a portion of the fibers 6, in alternate behavior at a consolidation position, i.e. a section 40 to be restrained or consolidated by a fluid 7 in counter flow. In this situation, the same fluid 7 can be employed, which, – for the purposes of the stretching – exhibits acceleration components in the stretching direction V and consolidates and accelerates fibers 6 at the consolidation section 41. In this variant arrangement, (not shown) further transport means are required, in order to transport the fibers 6 in the stretching direction V. Such transport means are, in some cases, also advantageous or necessary in the other described embodiments.

By the use of only one fluid 7, for the variants of the Figs. 2 and 3, in most cases, a single inlet 12 in the stretch chamber 1 suffices for the fluid 7, in order to achieve a separation of the fluid 7 in the stretch chamber 1, besides that embodiment shown in Fig. 1.

This is done by means of a proper choice of change of direction devices or several correspondingly directed nozzles. In this flow/counter flow, a first fluid sub-current takes over a greater acceleration of a portion of the fibers 6, while a second fluid sub flow tends to a slower flow (relative to the first) for another portion of the fibers 6. Care must be taken in respect to the respective second sub flow protective apparatuses, that turbulence in the stretch chamber disturbs neither the restraining nor the acceleration action. In accord with the invention, a fluid 7 can be employed essentially either only for the restraining or only for the acceleration of the fibers 6 – seen as respectively relative to one another.

As is also shown in Fig. 1, it is likewise possible to provide more than two consolidation sections 30, 31, or 40, 41. By this means, a more precise stretching can be achieved.

In an additional alternative (not shown), the fibers 6 are mechanically restrained or accelerated – for instance by one or more consolidation rolls. The restraining or the acceleration can also be carried out electronically and an apparatus can be constructed with oppositely poled components in the immediate neighborhood of the fibers to be consolidated or restrained.

In Fig. 4, a second embodiment of the invention provides, that alternative to the step-wise, successive sections of diminishing cross-sections 2, 3 4 of Fig. 1, nozzles 52, 53 are directed against the sections 50, 51 of the stretch chamber through which the fibers 6 are flowing. For the generation of the accelerating effect, in this case nozzles 53 are placed in the downstream located sections 51 of the stretch chamber 1 and which nozzles are essentially pointed in the stretching direction V. If, contrary to this, the fibers 6 should be previously restrained, then nozzles 52, advantageously, are located in the upstream sections 50 of the stretch chamber and, in the embodiment of Fig. 2, and directed contrary to the direction of stretching V, against the fibers to be restrained. Advantageously, in both cases respectively a plurality of nozzles 52, 53 are provided, which are placed about the entire zone of the fibers 6 in the stretching direction (not shown) and thus from almost all sides act upon the fibers.

This is done so that, on the average of the fiber bundle, a uniform stretching can take place. Additionally or alternatively, a plurality of nozzles 52, 53 are located along the stretching path, which all are directed in the stretching direction V and fluid with increasing pressure in the downstream direction is brought into the stretch chamber 1, in order to attain a successive greater acceleration of the fibers 6 (similar to the action in the apparatus shown in Fig. 1). In general, many variants of the nozzle arrangement and the pressure applied at these nozzles 50 are possible. Especially, these variants depend upon the purposes of the individual application and, likewise upon whether or not the fluid 7 is to apply a restraining or an accelerating force.

The first computations have produced the information, that the fluid 7 for fiber acceleration must flow at a pressure of some 12 - 15 atm, in order to exert the same pressure as a pulling roll on a consolidation width of a half a centimeter.

The process in accord with the invention and the apparatus in accord with the invention can be applied in the most varied areas of the spinning technology, in order to achieve a stretching of fibers. More explicitly, one can name carding and stretch machines.

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